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**Annual Newsletter and Bibliography of the
International Society of Plecopterologists**



Isoperla felderorum Roesti, 2021. Holotype male: Switzerland, canton of Bern, Bern, Aare [River] at Wylergut dam of the Felsenau power station, 46.96475, 7.44487, 496 m asl, April 21, 2020, coll. Christian Roesti with Flurina and Ladina Felder.

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The members of the Editorial Board quickly reviewed an early draft of the document. I also wish to thank contributors of obituaries by Tomáš Derka (Bratislava, Slovakia) and Lynn Lozier (Fairfax, California). Society members contributed laboratory summaries which made this issue of *Perla* fascinating reading. Christian Roesti (Bern, Switzerland) provided the cover photograph of the recently described *Isoperla felderorum* Roesti, 2021.

International Society of Plecopterologists Policy and Funds

As of 2021 the International Society of Plecopterologists (ISP) requires no dues for membership, nor for receiving *Perla*. *Perla* is now completely electronic and members may download the current and all past volumes from Plecoptera Species File (<http://plecoptera.speciesfile.org/>). We no longer send out printed copies unless they are specifically requested of the Managing Editor. Send requests to dewalt@illinois.edu.

The Managing Editor maintains an extensive list of current Plecoptera workers and students and new names are added as papers cross my desk for addition to Plecoptera Species File.

As Managing Editor of *Perla*, I can accept donations to support the organization. You may donate by using the following link: <https://inhs.web.illinois.edu/about/give/> or by sending a check to University of Illinois Foundation, P.O. Box 734500, Chicago, IL 60673-4500. In your communication please write in the memo field "Illinois Natural History Survey: Plecopterologists Society: DeWalt". These funds will be used to purchase supplies, pay for student travel scholarships, plaques for Lifetime Achievement recipients.

Currently, the Society has modest funds amounting to \$14,478. Expenses the past year have been non-existent.

Obituaries



Ilja Krno (1950-2021)

Obituary contributed by Tomáš Derka

Department of Ecology, Faculty of Natural Sciences, Comenius University Bratislava, Slovakia

Ilja Krno was born on May 27, 1950 in Moscow, Soviet Union, where his father Miloš, an antinazi resistance fighter and writer, worked at the Czechoslovak Embassy. As sincere Russophiles, the parents of the first-born son chose the name after one of the main characters of old legends of Slavic mythology, Ilja Muromec. Only a friend of his family, the great Russian writer Ilja Erenburg, thought that the boy was named after him. The family returned from Moscow to Czechoslovakia in 1953. Ilja lived ever since in the capital of Slovakia, Bratislava, where the Danube meets the Pannonian Plains and the Carpathians. When choosing a profession, he was guided by his father, who loved nature, as well as his grandfather, who was a pioneer in the Tatra Mountains historiography, promoter of evolution and Darwinism in Slovakia at the beginnings of the 20th century. In Bratislava he received primary, secondary and university education. He began his university studies at the Comenius University in Bratislava in the turbulent year 1968, a month after the occupation of Czechoslovakia by the Soviet army. He first

studied biology and chemistry, graduating in 1973 with a master's degree in zoology. Afterwards, he spent a year in compulsory military service, "defending" the western border of Czechoslovakia. After his military service, he returned to science. In his next career he was influenced by his doctoral supervisor Dr. Eva Ertlová from the Comenius University and by Prof. František Kubíček from the Masaryk University in Brno, Czech Republic. He completed doctoral studies in 1979, when he finished his study about structure and dynamics of benthic invertebrate communities of the Lupčianka river that flows in his father's homeland in northern Slovakia. After graduating he worked as a scientific assistant in the Institute of Zoology of the Faculty of Natural Sciences, Comenius University in Bratislava. From 1998 he worked as an assistant professor of hydrobiology, and from 2009, until his retirement in 2020, as a professor of ecology at the Department of Ecology.

Il'ja has dedicated his entire professional life to the study of benthic invertebrate communities and aquatic insects ecology. He specialized in ecology and taxonomy of stoneflies, but he was also an expert in ecology and identification of central European mayflies. He was the first author of the identification key of stonefly and mayfly nymphs of Slovakia. Il'ja loved mountains. In the highest part of the Carpathians, the Tatra Mountains in northern Slovakia, he discovered and described a new stonefly species *Leuctra pusilla* Krno, 1985. In his work he focused on the influence of ecological factors on the distribution and production ecology of benthic invertebrates in Central Europe, with the focus on stoneflies. He devoted a lot of effort to assessing the various human impacts, such as water pollution, flow regulation, deforestation, soil erosion, acidification, and land use, on the structural and functional properties of benthic invertebrate communities. He published about 240 original scientific papers, including 8 monographs and university textbooks. His publications have been cited almost 1500 times. There is no naturalist in Europe who deals with the ecology of stoneflies and does not meet with the name Il'ja Krno. However, as former students and colleagues, we especially appreciated his human dimension. Whether as a teacher, grant manager, or head of department, he was always kind, never raised his voice, never ruined the fun, and he always tried to help.

Il'ja Krno died suddenly during a spa treatment in Považská Bystrica, Slovakia, on October 17, 2021 at the age of 71. He left his wife Maria whom he met at the university, son Andrej, daughter Zora, three grandchildren and younger brothers Svätózár and Martin and many friends and colleagues. We will all miss him greatly.

Prof. I. Krno's most important publications concerning stoneflies:

1. Cívik J., Beracko P., **Krno I.**, Lánčzos T., Navara T., Derka T. 2021. The taxonomical and functional diversity of three groups of aquatic insects in rheocrene karst springs are affected by different environmental factors. *Limnologia* 91, DOI: 10.1016/j.limno.2021.125913
2. **Krno I.**, Žiak M., Lánčzos T., Beracko P., Šporcka F., Thomková K. 2021. Stoneflies (Plecoptera) of the Western Carpathians: does the geological bedrock influence their biodiversity? *Biologia*, DOI: 10.1007/s11756-021-00843-5
3. Beracko P., **Krno I.**, Lánčzos T. 2021. Key environmental drivers structuring stonefly assemblages in the mid-sized streams on the southern slope of the Western Carpathians. *Ecohydrology & Hydrobiology* 21(1): 164-176, DOI 10.1016/j.ecohyd.2020.06.003

4. Cívik, J., Beracko P., **Krno I.**, Derka T. 2020. Stonefly (Insecta: Plecoptera) assemblages of Western Carpathians Karst springs. *Entomofauna Carpathica* 1: 153-164.
5. **Krno I.**, Beracko P., Navara T., Šporka F., Elexová E.M. 2018. Changes in species composition of water insects during 25-year monitoring of the Danube floodplains affected by the Gabikovo waterworks. *Environmental Monitoring and Assessment* 190(7), DOI: 10.1007/s10661-018-6773-5
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Larry E. Serpa (1951-2021)

Aquatic Ecologist at The Nature Conservancy, Fairfax, California, United States
Obituary contributed by Lynn Lozier, February 2022

Larry Serpa, lover of streams and aquatic insects, passed away from T-cell lymphoma on May 17th, 2021. As an ecologist with The Nature Conservancy for his entire career, he was able to indulge his personal interest in aquatic invertebrates and amassed a meticulously documented collection of material from 50 California counties over 46 years. It has been donated to the California Academy of Sciences.

Larry spent his early years outdoors in the San Francisco Bay Area, hunting for snakes, lizards and insects. He attended San Rafael High School and there, on a class field trip to the desert, he met his partner in life, Lynn Lozier. He attended Cal Poly State University in San Luis Obispo studying Biology but transferred to Sonoma State University after two years to join Lynn. Larry and Lynn both received their BA and MA Biology degrees from that institution.

While in Sonoma County, Larry and Lynn lived on Sonoma Mountain and managed the Fairfield Osborn Preserve, for the University's Biology Department. Their caretaker duties for this natural area included designing and building a trail system, creating displays, compiling species lists and keeping weather records. In 1976, the Nature Conservancy, which owned the property, asked that they put together an environmental education program aimed at grade school children. Larry and Lynn designed a curriculum, recruited, and trained volunteer naturalists and launched a program, the first of its kind in the county. Through these guided explorations, generations of kids and their parents developed comfort in the natural world and had personal experiences with what biodiversity really means. Their care for the environment encouraged and informed generations of children and student naturalists. The program continues to this day.

The headwaters of Copeland Creek run through the Preserve. Larry began his Master's project hoping to do a synecological study of energy flow through that system. He surveyed the

vegetative community, captured, dried and weighed leaf fall, and then tried to document the animals in the aquatic realm. He was shocked to discover that although there was a rich and dynamic community of aquatic insects in this fishless stream, he could not identify them because they were juveniles, and the taxonomy is based on adult structures. So, he shifted his focus. In his master's thesis *The Rearing Imperative*, he reared nymphs from the creek's many microhabitats, so that when they matured, he was able to correlate them with the adults they emerged to be. He reared over 90 species and created a species-level key of those nymphs to assist future researchers.

As Larry began to work to identify adult aquatic insects, he reached out to experts for information. Richard Bauman and Vincent Resh were encouraging and generous with their engagement. Not being in an institution with taxonomic expertise, Larry felt that they "opened the door" for him to the professional world of aquatic entomology for which he was very grateful. Throughout his life, a number of taxonomists provided encouragement, feedback, advice, ideas and also questions he could explore. Larry shared sites and material with many. With John Sandberg, he especially enjoyed learning about *Calileuctra* drumming behavior. Larry loved to go out and look for some species that were little known or of interest to another colleague and with his ecological focus, he was often successful in finding them. Some of those explorations resulted in new records and more specimens. *Calileuctra ephemera* Shepard & Baumann, 1995 and *Paraleuctra divisa* (Hitchcock, 1958) are examples.

After graduating, working for The Nature Conservancy, Larry managed natural areas, assisted in preserve design, did restoration planning, evaluated properties for preservation, particularly the presence of special status amphibians, and led field trips known for both their humor and insights. His field work included searching for, and expanding the known distributions of many rare species including the California freshwater shrimp *Syncaris pacifica*, the Tomales isopod, *Caecidotea tomalensis*, a suite of vernal pool fairy shrimp; *Branchinecta conservatio*, *B. longiantenna*, *B. lynchi*, *B. sandiegonensis*, *Streptocephalus woottoni*, the vernal pool tadpole shrimp *Lepidurus packardi*, the Delta green ground beetle *Elaphrus viridis*, Rickseker's water scavenger beetle *Hydrochara rickseckeri*, and the Coastal tailed frog *Ascaphus truei*. In 1993, Larry supported and inspired the genesis of STRAW (Students and Teachers Restoring a Watershed). The program engages school children in understanding and caring about endangered species by actually having an impact in saving them. STRAW initially focused on creating habitat for the California freshwater shrimp. Today kids are planting to restore riparian habitat in support of biodiversity at sites across northern California.

Larry loved to explore new habitats, and to search for and find things that were unexpected. In 2008 at 10,300 feet (3140 m) asl, at a location above Ruby Lake in the high Sierra Nevada with his wife Lynn, she happened to catch an adult *Megaracys yosemite* (Perlodidae). Larry became fascinated with these high altitude beasts, an interest that expanded to include *Lednia sierra* (Nemouridae). Larry and Lynn undertook a project to try to determine the California distribution of both stoneflies. Not being backpackers, they identified all the trailheads to which they could drive that would get them up to 10,000 feet. Then each location was scoured using Topo and Google Earth to determine whether there might be likely habitat within day-hiking distance from that trailhead. Ultimately, Larry identified nine different jumping-off points. Over the course of ten summers, he and Lynn drove to these trail heads and then undertook lengthy day hikes even

higher to explore creeks, tributaries and snowfields. Most sites were searched for multiple years. In ten years of exploring, *M. yosemite* was found at six locations, and *L. sierra* at five places, most of them new localities, while five more apparently promising areas yielded neither species.

Larry was interested in “what lived where ” across the state’s freshwater microhabitats. His collection reflects over 3,000 collecting events across 50 of California’s 52 counties. In 46 years, he collected, and documented over 200,000 aquatic invertebrate specimens exploring diversity and distribution from sea level to over 11,000 feet. Material was meticulously documented in a relational database which, in addition to location, water temperature and vegetative community type also included significant details including microhabitat, collection method, type of specimen (nymph, adult), etc. The collection includes over 23,000 individually identified and labeled vials, as well as cases of bulk material linked with each collection event. Over 1,500 identified species are represented. Larry believed that what he documented would inform future understanding of ecosystems, how complex they are, and how they change over time. He wanted the specimens and the information they contain and represent to be available to aquatic entomologists all over the world. Consequently, his wife Lynn has donated his material to the California Academy of Sciences (CAS), making that institution’s aquatic insect collection the largest in California.

CAS reports that once specimen vials are processed with unique identifiers at the Academy, data will be uploaded to <https://monarch.calacademy.org/> (a Symbiota database), and pushed to data aggregators including iDigBio and GBIF. A fund has been set up to support the curation of this voluminous material; to date, about 1,200 specimen records have been uploaded, with tens of thousands remaining. In the meantime, the entire dataset without unique identifiers is available by request to the entomology collection manager, Chris Grinter.

Larry loved the natural world, starting with the smallest creatures. He felt himself a humble servant to the diversity of life. Colleagues remember his sense of wonder and his cynical wit, with a through-line of play and delight. Larry was a deeply knowledgeable naturalist, fortunate to apply his skills and passion for real conservation impact with The Nature Conservancy. He is remembered by generations of staff as an inspiring and generous mentor. We hope that his life’s work, this scientific legacy, will continue to encourage and support the work of those who care about biodiversity long into the future. Editor’s note: see CAS blog about the donation of Larry’s collection at <https://www.nature.org/en-us/newsroom/larry-serpa/>.

Bibliography of stonefly papers by Larry E. Serpa

1. Hotaling S, Giersch JJ, Finn DS, Tronstad LM, Jordan S, **Serpa LE**, Call RG, Muhlfeld CC, Weisrock DW (2019) Congruent population genetic structure but differing depths of divergence for three alpine stoneflies with similar ecology and geographic distributions. *Freshwater Biology* 64(2): 335–347. <https://doi.org/10.1111/fwb.13223>
2. Sandberg JB, **Serpa LE**, Drake EF (2015) The drumming signals of three winter stonefly species (Capniidae, Leuctridae: Plecoptera); with discussion resolving two common interval patterns. *Illiesia* 11(6): 51–74. <http://illiesia.speciesfile.org/papers/Illiesia11-06.pdf>
3. Stewart KW, Stark BP, **Serpa LE** (2013) Larvae of the two North American species of *Calileuctra* (Plecoptera: Leuctridae). *Illiesia* 9(1): 1–13. <http://illiesia.speciesfile.org/papers/Illiesia09-01.pdf>

The Emergence of the Newsletter PERLA and its Value to the International Stonefly Community

Richard W. Baumann. Monte L. Bean Life Science Museum, 290 MLBM, Brigham Young University, Provo, UT. 84602-5255. richard_baumann@byu.edu

In 1970 there had been four meetings of people that considered themselves plecopterologists or researchers that studied the stonefly order Plecoptera. These colleagues were all from Europe: J. Aubert, Switzerland; E. Pomeisi Austria; J. Illies, Germany and P. Brinck, Sweden. The first meeting was in Lausanne, Switzerland in 1956 and the last in Abisko, Sweden in 1968. Since I had interacted closely with three of the four when I was on a postdoctoral researcher at the Max-Planck Institute in Schlitz, Germany, I contacted them when I obtained a research position at the Smithsonian Institution in Washington, D. C. A proposal was made to hold an international symposium in the United States in Washington, D. C. in 1974. The organizing chairman was Joachim Illies and he had an international committee from throughout the world (Baumann 1976).

Meetings were held during the days of September 3-5, 1974. In addition, an informal evening event was held at the home of Oliver Flint, a trichopterist at the museum. Those in attendance will never forget the contest that took place between two esteemed colleagues: Joachim Illies and William Ricker. They found a guitar and proceeded to play and sing songs in the native language of the song and then would trade the guitar back and forth until the loser could not think of a new song. I do not remember who lost but the total number of songs sung was large.

Two proposals came from this symposium that all felt would be of great value to those that studied stoneflies anywhere in the world. First, that an International Commission should be formed that would provide an organized way to conduct business to aid all stonefly research colleagues. Second, a newsletter should be produced that would be an organ for easy communication. In fact, the first copy of PERLA No. 1 was distributed to all participants in Washington, D. C. The editors were Richard Baumann and Peter Zwick with art and layout by Rebecca Surdick. (This is because the Abisko meeting attendees in 1968 also made this proposal.)

PERLA 2-10 were printed and mailed out from Brigham Young University 1976-1991. The editors were Richard Baumann (BYU) and Peter Zwick, Max-Planck Limnology Institute, Schlitz, Germany.

PERLA 11-22 were printed and mailed out from North Texas State University, Denton, Texas. 1993-2004, Managing Editor Kenneth W. Stewart and Editorial Board.

PERLA 23-38 were printed and mailed from Colorado State University, Fort Collins, Colorado. 2005-2020, Managing Editor, Boris Kondratieff and Editorial Board.

The quality of the newsletter has been improved greatly and thanks are given to the editors. An International Plecoptera Committee was formed in 1975 that makes decisions about where and when international meetings should be held. The details and reports on international meetings 6-19 that were held from Schlitz, Germany (1977) to Aracruz, Brazil (2018) are included on line. It also gives out Lifetime Achievement Awards to colleagues that are deemed worthy. The workings of this committee are made available to all plecopterologists via the newsletter PERLA so these are additional reasons for PERLA to exist.

Baumann, R. W. 1976. A Report on the Fifth International Symposium on Plecoptera. Proceedings of the Biological Society of Washington, 88: 399-428.

Announcements

2022 XVITH INTERNATIONAL CONFERENCE ON EPHEMEROPTERA AND XXIST INTERNATIONAL SYMPOSIUM ON PLECOPTERA--A Virtual Affair

- We will host a virtual meeting during 25-29 (Monday-Friday) July. Save this entire date range. By May 1, exact dates and times will be settled. Dates are North American.
- No registration costs will be charged. All may attend.
- Meeting times will be staggered to accommodate colleagues in different time zones.
- The meeting will open with an introduction and plenary speakers placed in a single 3 hr time slot so that there is at least one time when we are all together and take a group photo.
- Posters will be grouped by topic and given a window of time for formal viewing.
- Oral presentations will be pre-recorded. The body of the talk is firmly 12 min. 3 minutes will be reserved for questions.

Final poster and oral presentations will be requested by organizers for 10 June delivery.

- We will provide blocks of time for committee meetings.
- The program will be available by 20 June in pdf format.
- Proceedings will be published in Zoosymposium (Magnolia Press). Authors will be encouraged to pay open access fees to Magnolia Press, but this is optional.
- Information will be sent by email and provided in *Perla* (download from <http://plecoptera.speciesfile.org>) and the *Mayfly Newsletter* (<https://dc.swosu.edu/mayfly>).

Call for abstracts. Please send abstracts April 1- May 15, 2022 to dewalt@illinois.edu and follow these formatting instructions:

- In the subject field write “MF/SF 2022 Abstract Submission”
- In a Word or compatible document format provide the follow:
 - Beginning line 1. A short descriptive title of no more than 20 words. Skip a line.
 - Provide author names as you wish to see them in print. Provide full First, Middle, Last names of authors and superscript numbers to indicate affiliation. Skip a line.
 - Each affiliation has its own line(s). Begin with the affiliation number as regular text. Follow with affiliations for institutions or home addresses for unaffiliated, add email addresses at end of affiliation. At the end of affiliations, skip a line to the body of the abstract.
 - Write an abstract of no more than 250 words. Make sure that it includes problem setup, brief objectives, and methods. Add the big picture results and short discussion of importance and conclusion. Skip a line.
 - Write “Keywords:” and add up to 5 words or phrases that would help people search for abstracts of interest. Skip a line.
 - Indicate your preferred presentation format: Poster or Oral presentation.
 - Organizers may change format if necessary. Time slots will be assigned by 1 June.
 - You will receive an acknowledgment of receipt of your abstract.

New FBA Publication on British and Irish stoneflies
Craig Macadam, Conservation Director, Buglife – The Invertebrate Conservation Trust

The current Freshwater Biological Association (FBA) key to British stoneflies by Noel Hynes was first published in 1958, and reprinted with small revisions in 1967 and 1977. This key has served ecologists well over the years however new taxonomic understanding, and the discovery of *Nemoura lacustris* Pictet, 1865 in England necessitated a new key to be produced.

A new publication from the FBA is now in preparation. Authored by Craig Macadam, Hugh Feeley and Jason Doe, the book will cover all 35 species found in Great Britain and Ireland. The key has been completely re-written and illustrated with line drawings. Species accounts have been produced covering the taxonomy, habitat, ecology, feeding, and distribution of all British and Irish species. They are illustrated with numerous photographs showing taxonomic features and their habitats.

This new book will be available from the Freshwater Biological Association (www.fba.org.uk) from April/May, 2022.

Plecoptera of the Jura Massif: Guide to identifying larvae by genus and species

Reding J-PG (2020). Les Plécoptères du Massif du Jura: Guide d'identification des larves au genre et à l'espèce Contents : 4 volumes (528 pp. ; 964 colour illustrations 6 x 8 cm) ISBN: 978-2-8399-2959-2 (in French)

Four volumes. See url for more information.

http://www.rossolis.ch/catalog/product_info.php?products_id=3540&osCsid=222087570f5b267ec0653ad5a7b2c513



Stoneflies of Switzerland

Christian Roesti (2021) Die Steinfliegen der Schweiz. Haupt Verlag. 632 pp. ISBN 978-3258082530 (in German)

See online preview here:

<https://issuu.com/haupt/docs/9783258082530?fr=sN2FIYTIwNDExNzU>

Purchase online here:

<https://www.haupt.ch/buecher/natur-garten/die-steinfliegen-der-schweiz.html>



IX ALL-RUSSIA SYMPOSIUM ON AMPHIBIOTIC INSECTS WITH INTERNATIONAL ATTENDANCE

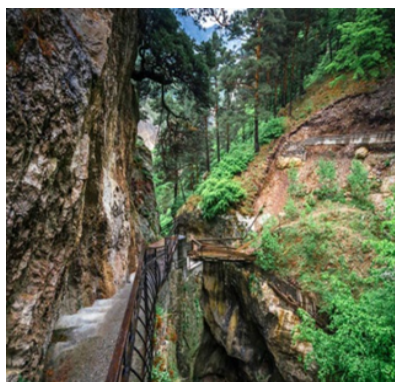
from 13st to 18nd May, 2023. Vladikavkaz, Russia

**NORTH-OSSETIAN STATE UNIVERSITY NAMED AFTER KOSTA
LEVANOVICH KHETAGUROV, FACULTY OF CHEMISTRY, BIOLOGY AND
BIOTECHNOLOGY (VLADIKAVKAZ)**

are organizing the

**IX ALL-RUSSIA SYMPOSIUM ON AMPHIBIOTIC INSECTS WITH
INTERNATIONAL ATTENDANCE**

The Symposium will take place in the North-Ossetian State University named after
K.L. Khetagurov, at the Faculty of Chemistry, Biology and Biotechnology



Kind regards,
Organizing Committee

Zootaxa Plecoptera: Co-Subject Editors update

In 2021, Subject Editorship for Plecoptera at Zootaxa passed to three individuals: Ed DeWalt (University of Illinois), Scott Grubbs (Western Kentucky University), and Dávid Muranyi (Eszterházy Károly University, Hungary). Because of the high volume of papers published in previous years and the workload that was placed on the previous subject editor, we enforced an existing Zootaxa policy that states that the journal publishes only taxonomic papers and does not publish single species descriptions without first meeting one or more preconditions (see Perla 39). In 2021, some 40 manuscripts were submitted. All were scrutinized before review to determine if preconditions for publication were met. five manuscripts were rejected outright. A total of 29 were shepherded to completion and six carried over to 2022. Three of the latter have published.

A predictable outcome of these preconditions were that Plecoptera scientists sent some 20 taxonomic papers to other suitable outlets such as Aquatic Insects, Natural History, and ZooKeys. At first blush, this seems negative for Zootaxa, but it is not. Taxonomic articles suffer from self-citation. Journal Citation Reports (JCR, Clarivate™) used algorithms that calculated impact factors that, until recently, downgraded the impact of taxonomic journals because of self-citation and within journal citations (Pinto et al. 2021). In fact, Zootaxa was suppressed from the Journal Citation Reports (JCR, Clarivate™), hence, no impact factor calculated for a short time. Complaints from the taxonomic community forced JCR to modify their algorithms, resulting in a 15% jump in impact factor for Zootaxa and increases for several taxonomic journals. Spreading our taxonomic papers to other journals helps Plecoptera science and strengthens other journals that publish taxonomic work. It also spreads the work of editing among more colleagues who freely donate their time to help stonefly taxonomists improve their important works.

Pinto ÂP, Mejdalani G, Mounce R, Silveira LF, Marinoni L, Rafael JA (2021) Are publications on zoological taxonomy under attack? Royal Society Open Science 8201617201617.
<http://doi.org/10.1098/rsos.201617>

Member News

Dora Hlebec. University of Zagreb, Faculty of Science, Zagreb, Croatia, dora.hlebec@gmail.com and Ignac Sivec. Slovenian Museum of Natural History, Ljubljana, Slovenia, isivec@pms-lj.si.

DNA barcoding for biodiversity assessment: Stoneflies of Croatia

The Dinaric Karst system represents one of the most diverse European freshwater habitats, including a variety of microhabitats, which resulted in speciation and endemism. As a part of Dora's PhD thesis within the project *DNA barcoding of Croatian faunal biodiversity* (IP-2016-06-9988), we conducted comprehensive field research on the stonefly fauna and applied DNA barcoding. Seventy-four morphospecies were confirmed for Croatia. Species delineation methods confirmed the existence of five divergent genetic lineages, which in addition to morphological differences from their congeners, represent distinct entities. Research has yielded the first molecular characterization of nine species that have mostly restricted distributions. Deep intraspecific genetic divergences within genera *Isoperla*, *Perla* and *Taeniopteryx* highlighted the need for taxonomic revision in several species-groups. The manuscript is in press in PeerJ.

***Isoperla popijaci*, a new stenoendemic stonefly species from Croatia**

Based on morphological (males and females adults, larval and eggs) and molecular data (sequencing of the DNA barcode region), we described a new *Isoperla* species. Based on the morphological characteristics, *Isoperla popijaci* belongs to the *I. tripartita* species-group and the lowest interspecific *p*-distance is 6.7%. *Isoperla popijaci* inhabits only two karstic sources of the intermittent rivulet Krasulja in Croatia, so the study puts emphasis on the conservation importance of the Dinaric Karst. The study was published in ZooKeys (<https://doi.org/10.3897/zookeys.1078.66382>).



Isoperla popijaci Hlebec & Sivec, 2021: Krasulja Rivulet, karstic source Ševerova Cave, 44°40.78'N, 15°37.87'E, 2 July 2021, I. Sivec. Photograph by Ignac Sivec.

***Taeniopteryx* n.sp. CRO-1: enigmatic status**

During comprehensive fieldwork we collected individuals which differ from all known species in the genus *Taeniopteryx* recorded in Croatia. Morphological differences are accompanied by genetic distinctiveness (interspecific *p*-distances ranged from 7.8–9.5%). As the genus *Taeniopteryx* is complex from a taxonomic point of view, we applied a multi-gene approach to resolve phylogenetic relationships among the species *T. schoenemundi* Mertens, 1923, *Taeniopteryx nebulosa* Linnaeus, 1758 and *T. hubaulti* Aubert, 1946. The manuscript is in progress.

Case of *Isoperla* cf. *lugens*

Specimens of *Isoperla* cf. *lugens* were found associated with the headwaters of several karstic rivers. These specimens differ morphologically from the typical *Isoperla lugens* and have exceptional genetic distinctiveness (the lowest interspecific *p*-distance is 6.7%). We applied a multi-gene approach to define the taxonomic status of *Isoperla* cf. *lugens* and we will try to resolve taxonomic relationships among other closely related *Isoperla* species. The manuscript is in progress.

Romolo Fochetti, DIBAF -University of Viterbo, Largo Università snc, 01100 Viterbo, Italy. fochetti@unitus.it

Together with A. Fausto (Tuscia University), I am studying the sperm patterns in European stoneflies. We studied the sperm structure of four species belonging to genera not analyzed in our previous studies, i.e., *Capnopsis schilleri* Rostock, *Amphinemura sulcicollis* Stephens, *Rhabdiopteryx neglecta* Albarda, *Tyrrhenoleuctra zavattarii* Consiglio, to whom it must be added the characterization of the spermatozoon of *Zwicknia gattolliati* (previously known as *Capnia bifrons*) and *Protonemura intricata* Ris, we discussed in a congress proceeding but never published so far. The results are being published.

The study of the sperm model of species belonging to families of the plecopterofauna of other continents (eg Notonemouridae, Scopuridae, Peltoperlidae etc.) is also envisaged, in order to obtain useful data to be used also for systematic purposes.

Besides, I have started the characterization of DNA barcodes of Italian Plecoptera, in collaboration with M. Oliverio (Sapienza University, Rome, Italy).

Also, together with friends and colleagues from Granada (Spain) I am continuing the study of molecular systematics and phylogeography of *Tyrrhenoleuctra* species.

Peter Zwick. Schwarzer Stock 9, D-36110 Schlitz, Germany. pleco-p.zwick@t-online.de

Transfer of Peter's collections to Staatliches Museum für Naturkunde, Stuttgart, Germany.

Although much of my work was on Plecoptera the stoneflies were not my first and not my only love. As a schoolboy I started with Coleoptera but shifted to Plecoptera in a thesis under J. Illies. During field work I then came across net-winged midges (Diptera: Blephariceridae) which fascinated me and became my third favourite. New species were named in all three orders, most beetles after 2012. Some time ago I decided that my collections of these groups should be safely stored for longer than I will probably be around. In November 2021 the collections, specimens

and related literature, were moved to the museum in Stuttgart where Dr. A. Staniczek is curator of aquatic insects.

The African species of genus *Neoperla*. My son Andreas (Canberra; molecular studies) and myself (morphology) continue with our long-distance cooperation on the Ethiopian *Neoperla*. Only a single African *Neoperla* has been recognized since 1952 but in our almost completed work we will document the existence of close to 80 endemic species in Africa. They belong to several species groups, one also with a few Asian species.

In the context of the African study I also looked at *Neoperla* from elsewhere and now work on a synopsis of *Neoperla* at the level of major species groups, including historical genus group taxa.

Chris Verdone. North Carolina Department of Environmental Quality, Division of Water Resources, Water Sciences Section, Biological Assessment Branch, Raleigh, NC, 27607, USA. chris.verdone@ncdenr.gov

***Acroneuria* synonymy – Chris Verdone, B. Kondratieff & E. South.** Beginning in 2016, we conducted a conservation status survey of *Acroneuria kosztarabi* Kondratieff & Kirchner, 1993, for the US Fish & Wildlife Service. We made new collections and examined specimens from the Illinois Natural History Survey, The Virginia Museum of Natural History, C.P. Gillette Museum, and the National Museum of Natural History. We barcoded and analyzed data for 31 *Acroneuria* and concluded that *A. kirchneri* Stark & Kondratieff, 2004 is a junior synonym of *A. kosztarabi*. The paper was just published in Zootaxa (<https://doi.org/10.11646/zootaxa.5094.1.8>).

Review of Nearctic *Strophopteryx* – Chris Verdone, S. Beaty, V. Holland, E. South & B. Kondratieff. In 2021, we collected what appeared to be *Strophopteryx arkansae* Ricker & Ross, 1975 in North Carolina. Subsequent barcoding has since suggested this NC population is a distinct, albeit cryptic, species. We (CV, ES, BK) will be traveling to Arkansas in March 2022 to collect fresh material of *S. arkansae* and *S. cucullata* Frison, 1934 for a review of the Nearctic species, which will include DNA analyses and color photographs of the adults and larvae.

Review of Eastern Nearctic *Oemopteryx* – Chris Verdone, S. Grubbs, S. Beaty, V. Holland, Bronwyn Williams. In 2021, while looking through old NCDWR benthic samples, I found a larva of *Oemopteryx* from the North Carolina Sandhills ecoregion, a strange location for the genus. Subsequent rearing efforts yielded adults that are distinctive both morphologically and genetically. We will examine loan material from the Illinois Natural History Survey and C.P. Gillette Museum, review the two other eastern Nearctic species and hopefully describe this new species in the next year using DNA barcoding, Scanning Electron Microscopy and color photographs. We are considering reviewing all the Nearctic larvae as well.

New species of *Isoperla* – S. Beaty, V. Holland, Chris Verdone & Bronwyn Williams. In 2020 and 2021, Bronwyn Williams barcoded 308 specimens of *Isoperla* Banks, 1906. Preliminary results suggest that we have 10 undescribed species of *Isoperla* from North Carolina and Virginia. Victor Holland has made arrangements for us to use the SEM lab at NC State so we can finish descriptions for three of these, known by the temporary names *I.* “NOT dicala”, *I.* “Mayo River” and *I.* “species 10”. Among the other new species, we have three more in the *I.*

pseudosimilis/similis group and a couple similar to *I. transmarina* (Newman, 1838) that we hope to make progress on this year.

Possible new species of *Remenus* – Chris Verdone, S. Beaty, V. Holland & Bronwyn Williams. In 2019, while looking for *Isoperla*, we mistakenly reared several *Remenus* Ricker, 1952 that were morphologically distinct from the other described species. We currently have records of this taxon from the Catawba and Green River basins in North Carolina. Preliminary results from DNA barcoding were inconclusive. This year Bronwyn Williams will attempt a population genomics study to better elucidate this taxon’s relationship to the other congeners.

Stoneflies of the Qualla Boundary - Rainee Tetreault, Chris Verdone, S. Beaty & V. Holland. The Qualla boundary is a land trust governed by the Eastern Band of Cherokee Indians in western North Carolina. In 2021, I was contacted by Rainee Tetreault, biologist in charge of water quality monitoring for the Eastern Band of Cherokee. She was interested in learning about adult stoneflies and collection methods to survey for species petitioned for endangered species listing. What began as an instructional visit has evolved into a longer term survey to document the stoneflies of the Qualla Boundary, which includes many outstanding creeks and rivers like Raven Fork, Bunches Creek and the Oconaluftee River. Although we have only spent four days surveying thus far we have documented 42 species of stoneflies, including some stellar taxa like *Megaleuctra williamsae* Hanson, 1941, *Remenus duffieldi* Nelson & Kondratieff, 1995, *Allocapnia stannardi* Ross, 1964, and *A. fumosa* Ross, 1964. We hope to carve out a few days every other month over the next few years to develop a comprehensive checklist for the area.



An undescribed *Isoperla* (*pseudosimilis* group) species awaiting description. Virginia, Scott County, Devils Fork, 8 May 2017, C. Verdone, B. Kondratieff. Photograph by C. Verdone.

Scott A. Grubbs, Western Kentucky University, Biology Department, Bowling Green, Kentucky, USA. scott.grubbs@wku.edu

Eastern Nearctic Nemourinae

The treatment of eastern Nearctic Nemourinae with Richard Baumann is slowly approaching completion. We have assembled plates for all species consisting of line drawings and scanning electron micrographs. Digital light microscopy imaging is the last task before this monograph can be submitted for publication (journal TBD). This treatment will complement previous monographs on eastern Nearctic Chloroperlidae (Surdick 2004), Peltoperlidae (Stark 2000), Perlidae (Stark 2004), Perlodidae – Isoperlinae (Szczytko and Kondratieff 2015), Perlodidae – Perlodinae (Kondratieff 2004), Pteronarcyidae (Nelson 2000), and Taeniopterygidae (Stewart 2000).

Systematics and taxonomy eastern Nearctic *Leuctra*

This is a collaborative project with several individuals, namely Ed DeWalt (INHS), Ruthie Eastham (current WKU undergraduate student, Madison Layer (current WKU M.S. student), and Madeline Metzger (former WKU M.S. student). Ed and I are collaborating on a conservation and taxonomic assessment of the Louisiana Needlefly *L. szczytkoi* presently funded by the U.S. Fish and Wildlife Service. The related species *L. paleo* is presumed to be a junior synonym (Harrison & Stark 2010, *Illiesia* 6(03):16-33). Ed and I collected fresh *L. paleo* and *L. szczytko* specimens in October 2020 from both type localities and other localities and DNA barcoded them, demonstrating approximately 1% sequence divergence. In October 2021, we successfully collected more populations of *L. szczytkoi* in central and western Louisiana and found *Leuctra* (larvae only) for the first time in Texas (Sabine and Jasper counties). A second plate of tissue is now being barcoded to identify the larvae. We are currently working on both a systematics treatment and a broader conservation ecology paper. I had successful trips in October-December 2021 to collect fresh *L. cottaquilla* in Alabama and both *L. colemanorum* and *L. hicksi* in Mississippi. All of the species mentioned are part of Madison's project on the systematics and phylogeography of the *L. ferruginea* Group. Ruthie is performing a parallel treatment of the *L. tenuis* group, and I am working on the *L. biloba* and *L. grandis* groups. Spring-summer 2022 collecting will target fresh material of *L. usdi* (*L. tenuis* group), *L. crossi* (unplaced), *L. monticola* and *L. pinhoti* (*L. biloba* group), late May-emerging populations determined as *L. tenuis*, a potentially undescribed species similar to *L. ferruginea*, and a June-emergent population of *L. variabilis* (*L. tenuis* group).

New North American *Perlesta* (Perlidae)

Ed DeWalt and I have at least two undescribed species from eastern USA that we hope to describe by the end of 2022. Fieldwork in Indiana, Michigan, Minnesota, and Wisconsin is planned to collect fresh material of both species for morphological description and to expand upon the partial barcode-based phylogenetic treatment of the genus presented in South et al. (2019).

Update - Maryland Plecoptera

Phillip Hogan (former WKU M.S. student) completed his two-part thesis on Maryland stoneflies. The emphasis was on the Appalachian portion of the state in its western panhandle. Part 1 was a

distributional modeling assessment of several uncommon/rare Appalachian species, most have been listed as Species of Greatest Conservation Need on at least one USA State Wildlife Action Plan. Part 2 was a first attempt at a distributional atlas of the Appalachian Maryland Plecoptera. Manuscripts of both parts are in progress.

USA Northeast Regional Species of Greatest Conservation Need (RSGCN)

The U.S. Fish & Wildlife Service has earmarked \$300,000 to fund conservation status assessments of 33 RSGCN species in 13 northeastern USA states. The species were proposed as RSGCNs by Ed DeWalt, Boris Kondratieff, Luke Myers, and me during a collaboration in 2020. Funding will start in 2023 for a four-year project. We are in early planning phases. Field work prioritizes 13 RSGCNs “Priority 1” species for fieldwork: *Acroneuria arida*, *Acroneuria flinti*, *Allocapnia frumi*, *Alloperla vostoki*, *Diura washingtoniana*, *Isoperla major*, *Isoperla myersi*, *Leuctra laura*, *Leuctra monticola*, *Neoperla mainensis*, *Soyedina merritti*, *Sweltsa holstenensis*, and *Taeniopteryx nelsoni*. Other objectives include compilation of museum and literature specimen data for all 33 species, the development of standard operating protocols for field and museum work, and training of graduate students, state and regional conservation staff, and select volunteers to help with data collection.

Mount Washington and Presidential Range Plecoptera

The Presidential Range is part of the White Mountains of the USA state of New Hampshire. Its peaks are named for several 19th century USA presidents. Mount Washington, the highest peak in the range, towers at 1,917 m (= 6,288 ft). Because of its elevation, latitude, and brutally cold, unpredictable weather, the mountain is home to several populations of species known nowhere else in the world or are present as disjunct populations with Holarctic distributions. The USA Forest Service and state of New Hampshire provided research permits to Ed DeWalt, Luke Myers, and myself to collect Mount Washington during summer 2021 principally to find *Diura washingtoniana* (endemic), *Arcynopteryx dichroa* (disjunct), *Leuctra laura* (endemic), and *Zapada katahdin* (disjunct or continuous to Mount Katahdin, Maine, USA). We were successful in collecting larvae of *A. dichroa* (Cutler River at Huntington Ravine Trail) and *D. washingtoniana* larvae and one adult male (Upper Lakes of the Clouds, a glacial tarn). The record of *A. dichroa* is remarkable in that the closest known populations are in ca. 1,430 km westward (= ca. 890 mi) in western Lake Superior. Sampling in and near Mount Washington produced 17 new state records. DNA barcoding of *D. washingtoniana* and *A. dichroa* is planned to compare to congeners and other disjunct populations, respectively. Future trips are planned to continue work on Mount Washington and expand to other peaks in the Presidential range to find other locations for *D. washingtoniana* and other rare species.

Manuel Tierno de Figueroa and Manuel J. López Rodríguez. University of Granada, Departments of Zoology and Ecology, Granada, Spain, jmtdef@ugr.es, manujlr@ugr.es

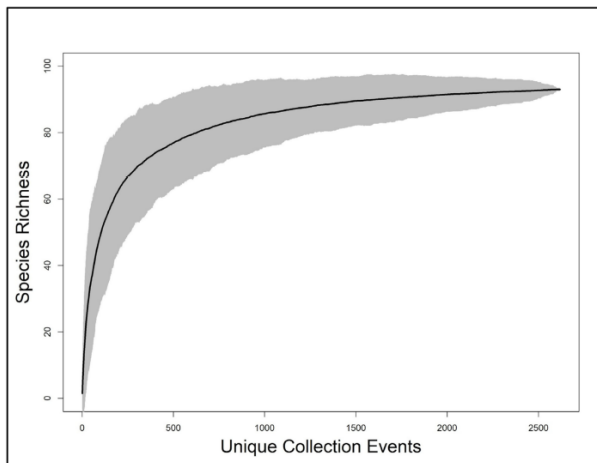
Currently we are sampling macroinvertebrates, particularly Plecoptera and Trichoptera, in Sierra Nevada National Park (Southern Spain) within the European project LIFE Watch-ERIC (N/REF LifeWatch-2019-10-UGR-01). We will analyze some stonefly populations from the demographical point of view in three reaches at different altitudes within the same stream course. We are also conducting monthly sampling in seasonal streams of the Guadiana Basin (Spain) to

study the metacommunity structure and the biology and demography of particular species of stoneflies, in order to discuss if they may be used as “sentinel species” of climate change. This is part of a project recently funded by the European Commission through the regional government (*Junta de Andalucía*, Spain) and the University of Granada, in which we are going to analyze the genetic structure of several populations of Plecoptera too in order to detect if they behave as a metapopulation and their conservation status. On the other hand, we are finalizing (together with Drs. Julio Luzón-Ortega, Patrizia Vannucchi and Romolo Fochetti) a work on the drumming behavior and the molecular characterization of several populations of the genus *Tyrrhenoleuctra* from Spain and (together with Drs. Cristina Trenzado-Romero and Ramón Carmona) a study on the histology of the digestive tract of several species of Plecoptera aimed at determining the possible existence of differences between species and within a same species with different development stages and with different diets.

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Phylogenomics of North American Plecoptera. Eric J. South finished his PhD dissertation in December, 2020, publishing his main chapter using transcriptomes and 95% of the genera present in North America (<https://doi.org/10.1111/syen.12462>). He followed this up with a phylogenomic analysis of most members of the Paraperlinae and several outgroups and morphological description of the first new family since 1987, Kathroperlidae Banks, 1948 (not South & DeWalt 2021, see <https://doi.org/10.1093/isd/ixab014>). Banks described the subfamily Kathroperlinae under the Perlidae, an act previously unrecorded in Plecoptera literature. Eric now has an assistant professor position at Lyon College, Batesville, Arkansas, USA.

Plecoptera of Indiana. Evan A. Newman graduated with a master’s degree in December, 2021. One chapter is published on a watershed based analysis of the diversity of stoneflies in Indiana, a Midwest, USA state (<https://doi.org/10.3390/d13120672>). From 5330 specimen records he found 93 species (including one undescribed *Perlesta*). Species richness was near saturated with terminal prediction of 95 ± 5 species. The total is intermediate between Ohio (103 species) to the east and Illinois (80) to the west. US Geological Survey HUC8 scale watersheds with the highest



richness were those in southern unglaciated and once-glaciated (Illinoisan glacial event) drainages. Species richness patterns were supported by relationships with several hydrological variables and watershed drainage area. A distribution atlas of the Plecoptera of Indiana is in construction in Biodiversity Data Journal and a third paper is planned to formally rank conservation status of species using the NatureServe rank calculator for USA states. Scott A. Grubbs is a valued advisor and coauthor on these papers.

Search for Illinois 72 Watchlisted Plecoptera, Ephemeroptera, and Trichoptera. This four year project, funded by the state of Illinois, examines all parts of the state for 72 Watchlisted EPT species as defined in the Illinois Wildlife Action Plan of 2015. Species that entered the list were rare contemporarily or had been known historically but not found recently. Stoneflies once thought extirpated, *Attaneuria ruralis* (Perlidae) and *Isogenoides varians* (Perlodidae), have been found with concerted sampling effort. Light trap collections at two locations on the Mississippi River produces males of *A. ruralis* and April investigations along large rivers found exuvia of *I. varians* on the Mississippi and Wabash rivers on opposite borders of the state--the first occurrence records for five decades. The rare *Allocapnia smithi* (Capniidae), *Leuctra alta*, *Zealeuctra narfi* (Leuctridae), and *Prostoia hallasi* (Nemouridae) have been found in several intermittent streams in the Shawnee Hills of southern Illinois, an east-west ridge vaulted 100-200 m above the surrounding landscape. Finding stoneflies new to Illinois is rare. Boris Kondratieff, collecting at a 2019 North American Plecoptera Symposium function found *Alloperla hamata* (Chloroperlidae) in a small stream of the Shawnee Hills. Extensive collecting since then has not produced other locations. This work has also yielded many new mayfly and caddisfly records for Illinois. Unfortunately, we have only found 43 of the 72 Watchlisted species with late winter and spring collections to go before analysis and report writing this summer.

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Distribution modeling study of the midwestern USA (Illinois, Indiana, Iowa, Michigan, Minnesota, Ohio, and Wisconsin) stonefly assemblage. Using a dataset of 38,000 records, distribution modeling is being employed to describe range dynamics following European settlement of the Midwest, identify habitat for uncommon species, and aid in the development of conservation assessments for each species modeled.

Phylogeographic analysis of the eastern Nearctic genus *Allocapnia* Claassen, 1924. This research addresses the post-glacial dispersal hypotheses summarized by Ross & Ricker (1971) using haplotype networks and distribution modeling. Additional predicted outcomes of this research include an updated review and a complete phylogeny of the *Allocapnia*.

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Observations of crumpled wings in stoneflies (Plecoptera). Further to our paper (as titled above; pdf available via ResearchGate [here](#)), my colleague Craig Macadam and I wish to draw your attention to our increased observations of wing ‘crumpling’ in Irish and British stonefly populations. We have now observed the phenomenon in all families found in our respective islands. We are wondering if this is a case of Baader-Meinhof phenomenon or if it is in fact an increasingly common phenomenon in our stonefly populations? Several theories are proposed (see paper) but potential climate effects and related degree-days are also a consideration. Should anyone have noticed a similar increase in observations of this phenomenon in their respective

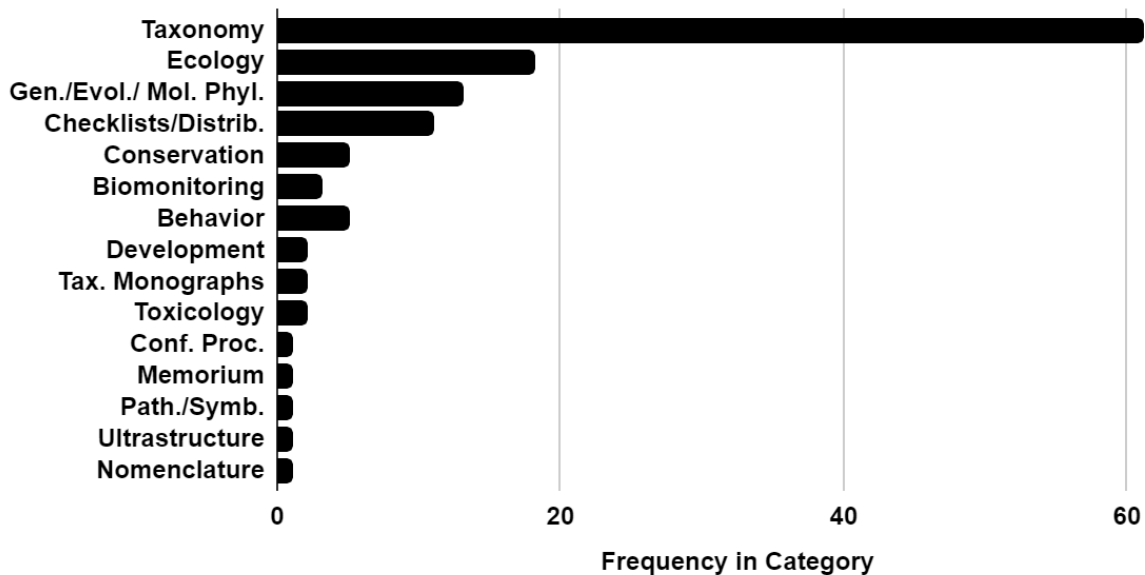
territory please get in touch, or if you have a theory as to its cause we would be very interested to hear from you.



Photo of wing crumpling in *Capnia atra* (Capniidae) taken in Ireland (Hugh Feeley).

Recent Plecoptera Literature

A total of 127 references were found in the literature with significant attribution to stoneflies. All but three references are 2021 publications. Three 2020 publications came out late in that year and two in the first days of 2022. Compared to the total, 48% of all papers were taxonomic treatments. Ecology was the next largest category with 14%, while Genetics/Evolution/Molecular Phylogeny and Phylogeography contributed 12% of papers. If you wish to have a Bibtext file of the references send a request to dewalt@illinois.edu.



Note that Reding (2020) published a monograph on the stoneflies of the Jura Massif with identification keys for nymphs at genus and species level collected from the French and Swiss Jura Massif. Also note that Roesti (2021) published a monograph of the adult stoneflies of Switzerland. A new species, *Isoperla felderorum* Roesti, 2021 was described in the volume. This volume is richly illustrated, allowing identification of some 126 species. It is also useful to identify adult stoneflies in Austria and Germany.

Some real headway was made in Plecoptera phylogeny this year with South et al.'s (2021a, 2021b) work on a transcriptome-based phylogeny of North American stoneflies. The broader study led to the formal description of a new family, the first since 1987. Kathroperlidae Banks, 1948 ("Kathroperlinae Banks, 1948" was not in anyone's catalog) was characterized morphologically and demonstrated to be distinct from all other Systellognatha families and the distinct Paraperlinae using phylogenomics. An updated key to families in the Systellognatha was produced. Letsch et al. (2021), combined both transcriptomic and Sanger sequence datasets to test timing, place of origin, and subsequent migration of stoneflies. They suggest that ancestral stoneflies originated in the northern hemisphere around 265 Ma (Béthoux et al. put one fossil group into Pennsylvanian around 300 Ma) with the two suborders originating there. They also suggest that both groups dispersed to Gondwana before its breakup with Notonemouridae and Antartoperlaria becoming extinct in the north. Their data set lacks representatives from a few key families, Notonemouridae being one, so there seems room for improvement. Of course, relationships between families and genera are still poorly understood.

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Allocapnia loshada Ricker, 1952 (Capniidae): Virginia, Wythe County, Stony Fork, Hwy 52, Dark Hollow Picnic Area, 36.98198, -81.18729, 21 December 2019, C. Verdone. Photograph by C. Verdone.



Allocapnia loshada Ricker, 1952 (Capniidae): Virginia, Smyth County, unnamed tributary to Bear Creek, National Forest Rd. 6251, Newman Hollow, 36.90664, -81.416476, 20 December 2019, C. Verdone. Photograph by C. Verdone.



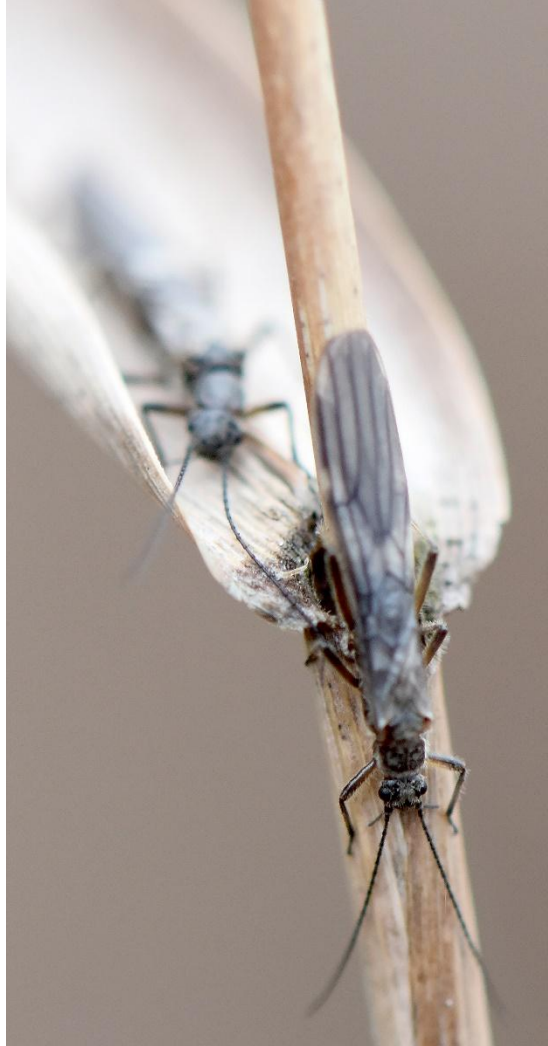
Isoperla pseudosimilis Szczytko & Kondratieff, 2015 (Perlodidae): Virginia, Giles County, spring tributary to White Rock Branch, White Rock Recreation Area, 37.42994, -80.49331, 4 May 2019, Chris Verdone. Photograph by C. Verdone.



Malirekus hastatus (Banks, 1920) (Perlodidae): North Carolina, Alleghany County, unnamed tributary to Big Sandy Creek, Stone Mountain State Park, 36.380699, -81.019635, 7 April 2021, C. Verdone. Photograph by C. Verdone.



Malirekus hastatus (Banks, 1920) (Perlodidae): North Carolina, Alleghany County, unnamed tributary to Big Sandy Creek, Stone Mountain State Park, 36.380699, -81.019635, 7 April 2021, C. Verdone. Photograph by C. Verdone.



Nemocapnia carolina Banks, 1938 (Capniidae): North Carolina, Franklin County, Tar River, Sledge Rd., 35.94110, -78.20310, 15 January 2019, C. Verdone. Photograph by C. Verdone.



Pteronarcys scotti Ricker, 1952 (Pteronarcyidae): North Carolina, McDowell County, Toms Creek, Huskins Branch Rd., 35.77381, -82.05686, 23 May 2021, C. Verdone. Photograph by C. Verdone.



Prostoia besametsa (Ricker, 1952) (Nemouridae): Colorado, Larimer County, Poudre River, Salyer Natural Area, 40.59870, -105.08386, 31 March 2018, C. Verdone. Photograph by C. Verdone.



Skwala americana (Klapálek, 1912) (Perlodidae): Colorado, Larimer County, Poudre River, Salyer Natural Area, 40.59870, -105.08386, 31 March 2018, C. Verdone. Photograph by C. Verdone.



Yugus bulbosus (Frison, 1942) (Perlodidae): North Carolina, Macon County, Long Branch, Upper Nantahala Rd., 35.07527, -83.52727, 26 May 2018, C. Verdone. Photograph by C. Verdone.

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